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Study on the new technologies that will boost hydrogen as a global energy vector

Abstract

The emission of greenhouse gases (GHG) into the atmosphere represents a real problem and a great challenge for the following decades; the effects of climate change are already palpable: warmer temperatures, ocean and sea level rise as well increased frequency of high precipitations events. Further warming will inevitably occur in the decades to come-the question is whether it can be limited to two degree rise-and will place higher pressure on ecosystems and human populations, particularly those living in *tropical areas*. Middle and upper classes of emerging countries increased their CO_2e emissionmore than any other group within the past 15 years. The new geography of global emitters calls for climate action in all countries.[1] Based on our new global energy paradigm; the present work aims to carry out a study in the field for renewable energies, on the great potential that would take advantage of the use of hydrological resources available in the potential zones of the developing economies, on the production and use of Hydrogen as a clean energy vector like a promising source and sustainable economy in the coming years. Overpopulation, uncontrolled massive migratory flows and the current Codiv-19 pandemic, all this coincides and is presented in a timely manner; given the current energy situation, which is practically becoming unsustainable, due to the intense and irrational use of fossil fuel. Which as a consequence of this the entire planet is suffering the effects of global warming; which failure to reverse the situation will cause major environmental catastrophes in the short term.

Hydrogen, the most abundant element of the universe since it is not free in nature, is necessary to produce it from hydrogenatedsubstances, mainly water and hydrocarbons. The easy availability and abundance of the material from which hydrogen can be obtained, as well as the diversity of means to obtain it; provide a great potential as an energy alternative. This, coupled with the fact that the use of hydrogen only leaves water as the only residue; makes it very favorable to the environment, looking for ways to produce it only with renewable energy sources, such as solar, wind, hydraulic, among others. These characteristics will boost energy economy basedabundant hydrogen.[2]

In order to have a clear and general idea of the research project to be carried out, it will begin with a study in different segments, given the extensive information required, it will begin as follows:

Firstable an analysis of greenhouse gas emission globally; what countries lead the most greenhouse emission to the atmosphere. Second the new trends and research that involved the hydrogen inadvanced economies.

What recent technologies will drive the massive consumption of hydrogen globally? To respond this question, It will be investigated what countries that currently lead the use of hydrogen and which technologies currently are already demanding a significant consumption of hydrogen, then will be analyzed data collected from studies about this new energetic paradigm, and if there is a correlation between population growth, percentage of energy demand, geographical area and the technological services sector. Variables obtained will be graphed and analyzed; and finally some preliminary results will be reported in the present work.

Keywords: hydrogen, greenhouse gas, fossil CO_2 emissions, sustainable, renewable energy, hydrological resources, SDGs 2030 (thesustainable development goals-2030).

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Introduction

Hydrogen is the most abundant in the universe and yet, on Earth, it is rarely in a free state. Hydrogen is a carrier of energy (such as electricity), it is necessary to produce it from other raw materials (water, biomass, fossil resources), and to convert these matters in hydrogen must follow some transformations in which it is consumed some primary energy source (nuclear, renewable or fossil). Hydrogen is currently used in many industrial processes, therefore, what is emerging in the present moment is the use of hydrogen as a new energy vector that allows compatible development with respect for the environment. On the other hand, hydrogen offers in the long term intrinsically clean closed energy cycle scenario that's constitutes the great attraction of this carrier of energy. It´s about drinking water from nature, separating it into its components (oxygen and hydrogen) by means of electricity of renewable origin, storing hydrogen, transporting it, distributing it and, finally when using it following conventional thermal processes (internal combustion engines or turbines), orelectrochemicals novelty (fuel cells), we would return the same amount to nature of water that we had previously taken from it. In the thermal conversion of hydrogen nitrogen oxides would be emitted (although in a much lower proportion than those emitted with fossil fuels), while in use with batteries of fuel emissions would be zero.

With renewable energy and water, and using hydrogen and electricity as energy vectors, it would be possible to meet all energy needs with an emission of pollutants practically null. If an energetic scenario of this style comes into being, then it could be said that the "hydrogen revolution" would have occurred and we would have entered the era of hydrogen. In the evolution towards a future energy scenario in which hydrogen (as an energy carrier); for first time in history the establishment will break through of an energy system based on natural resources (renewable and water), the depletion of fossil fuels is a incontestable fact; that is way it is necessary to lead Humanity towards a safer, durable and non- polluting energy system. Hydrogen, together with renewable electricity as energy carriers offers this possibility.

In the path towards this goal there are no insurmountable technical and economic effort is required constant for a few decades.[3] Though there are several processes to produce hydrogen, 95% of today´s hydrogen is produced by a thermal process called steam methane reformation where natural gas and high-temperature steam are combined to generate carbon dioxide and hydrogen. The hydrogen is extracted and is then used for refining petroleum, treating metals, ammonia for fertilizer, and processing foods. Unfortunately, because natural gas is a fossil fuel, the carbon dioxide that is released during the steam methane reforming process only add to the existing greenhouse gas emissions.

Transportation fuels such as gasoline and diesel emit harmful substances and are a, if note the, major source of pollution which impacts the environment and our health. Currently, hydrogen remains in the early stages of being used as a transportation fuel; but has the potential to significantly reduce emissions in the transportation sector. Producing hydrogen from sustainable domestic and renewable energy resources, addresses pollution, climate change, and other planetary concerns. When combined with oxygen in a fuel cell, hydrogen produces heat and electricity and is a clean-burning fuel. When used in a Fuel Cell Vehicles (FCV), the only tailpipe emission is water vapor. FCVs can replicate today´s driving experience in traveling 300 to 400 miles on a tank of hydrogen fuel. A kilogram of hydrogen gas is the equivalent of 2.8 kilograms of gasoline in terms of energy.

Replacing fossil fueled transportations with hydrogen fuel will provide cleaner air, especially in cities and areas with heavy traffic. When hydrogen production is derived from low-emission sources, additional health benefits are achieved.[4] Dr. Alejandro Rojo Valerio, director of the Center for Research in Automotive Mechatronics (CIMA), of the Tecnológico de Monterrey, Toluca campus, affirms that we are living a transition stage: "The studies mark that, by 2040, more than 50% of the vehicles of the world will be electric; it is expected that by 2060 half of the electric vehicles will be powered by hydrogen". Four kilos of compressed hydrogen are enough to cover 400 kilometers at price similar to gasoline, but being lighter, it makes cars that use gasoline less heavy. "Three times more kilocalories are obtained per gram of hydrogen than gasoline itself (Figure 1). That is a very interesting attraction", says Arturo Fernandez Madrigal, a researcher at the Institute of Renewable Energies of the UNAM and a member of the Mexican Academy of Sciences. Is hydrogen a solution to the energy requirements of today's societies? "yes it can be", shares Dafne Daniela Jacobo Davila, president of the Aeronautics Academy. The water vapor that is produced from the generation of energy with hydrogen would help to clean the atmosphere of harmful gases, says this researcher from the National Polytechnic Institute (IPN), developed a hydrogen-based engine for an aircraft. In that project led by Brian Oribio Alarcón, "the polluting gases were zero" and "the engine power did not show changes in relation to the use of fossil fuels, "says Jacobo Davila, who says that the energy of this fuel gives off four times less heat than fossil fuels, that is, it is more efficient.

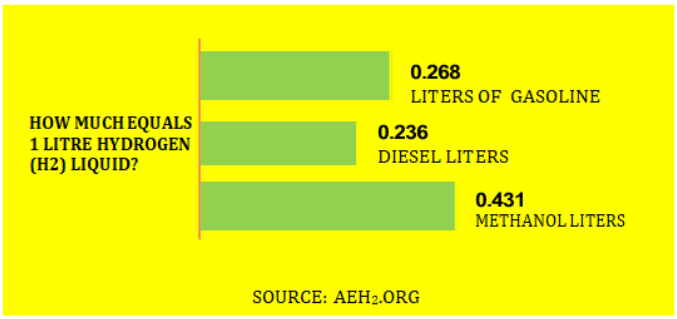

Figure 1 Hydrogen comparative with others fuels (Retrieved from http://aeh2.org/index.php?option=com_ntent&view=category&layout=blog&id=44&Itemid=41&lang=es)

If it sounds so good, why aren`t we using hydrogen in cars, ships, planes and in the industry? A drawback is that 95% of the world`s hydrogen is obtained through a process of burning hydrocarbons where greenhouse gases such as carbon dioxide are released. To achieve a "green hydrogen", from oxygen. However, only 5% of hydrogen production is thus obtained. Is it possible to achieve electrolysis on and industrial scale to obtain hydrogen? "It is possible and perhaps a little expensive; Due to the way of production, it does not require much maintenance, but the fuel generating device is expensive.

However, that raw material, which is salt water, is abundant", explains Dafne Jacobo Dávila. Renewable methods for hydrogen production are currently being promoted; "for example, with the use of biomass, where methane is obtained and the hydrogen, or photoelectrolysis, use sunlight by illuminating solar cells that give us electricity that is used for water electrolysis", shares Arturo Fernández Madrigal, who also collaborates with the National Renewable Energy Laboratory DOE-USA in the preparation of semiconductor materials for the production of renewable hydrogen. In the case of photoelectrolysis, the photon of solar radiation helps to separate the molecule of water into hydrogen and oxygen.

Fernández Madrigal thinks that we are living a transition from hybrid models, which use gasoline and electricity, to electric ones; finally, hydrogen will arrive. But there is still a proper legal framework. The price of fuels, the pressure to reduce toxic emissions in the environment coupled with the need to innovate in transport option increase competition between technologies and auotmakers in the race for electric mobility.[5] Sergio Gomez Lora, general director of the IQOM consulting firm, emphasizes that the country`s manufacturing industry needs to move towards new technologies, such as electric cars.

The automotive sector is not the only attractive niche for technological investment. Agribusiness, the pharmaceutical sector, the development of bio-foods, hydrocarbons and medical devices have great growth potential, according to Rogelio Garza, ex sub secretary of Industry and Commerce of the Ministry of Economy.[6] The industry has changed in the las 10 years and will continue to change, there will be more sustainable products. In the year 2040, renewable energies will continue to gain ground and, when combined with natural gas, and emerging technologies, such as micro-networks, they will be able to create energy efficient, robust systems of high efficiency of high efficiency and low carbon emission. Advanced biofuelsare envisioned

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through algae, carbon sequestration and new hydrogen- associated technologies.

In 50 years it will reach between 60% and 70% of the total electricity generation worldwide. For the new renewable generation, there are two promising technologies. First we will see a quantum leap with hydrogen, which still has limitation, but it will be a discruptive and competitive technology against batteries to store energy. Then the tidal-wave force, where there are some generation prototypes with currents.[7] In the next 10 years we will experience the results of advances in artificial intelligence (IA), and increase in quality standards, control and immediate responses. There will be a closer collaboration between nations, private and governmental entities, and there will be more stringent approaches to ecological, social and economic.[8] The characteristics of hydrogen as a fuel have been known for decades and are used today with some breadth in industries such as electricity generator, because is a residue of several petrochemical processes.

"But the challenge is to reach a method so that, through the separation of hydrogen from the molecule of water, the extra energy that comes from the electrical generation in solar and wind plants can be stored" says the International Energy Agency in its report "*The future of hydrogen: measuring today`s opportunities*", published this year at the G20 meeting in Japan.[9] The global demand for hydrogen fuel is expected to grow rapidly over the next decade. Government climate targets, for example, call for the number of hydrogen-powered cars to road worldwide to increase to 2.5 million by 2030 from about 11,000 in 2018. Hydrogen is valued as a zero carbon emission fuel, but the way it´s produced determines its ultimate carbon foot print. About 95 percent of the commercial hydrogen, which is derived from natural gas, is called "gray hydrogen," because its production releases large volumes of carbon dioxide, about 9 parts carbon dioxide to every 1 part of hydrogen.

The hydrogen is clasisified as "blue" if the carbon dioxide is captured before it is released into the atmosphere and stored, a process that increases production cost by about 40 percent, according to S&P Global Platts. "Green hydrogen" is produced through a process known as a electrolysis, in which electricity generated by wind, solar and other renewable energy sources separates hydrogen atoms from oxygen atoms bonded together in water. The process releases no carbon dioxide but is the most expensive, at least triple the cost of gray hydrogen, according to the International Energy Agency.[10] Today fossil fuels are the ultimate source of 85% of energy. But this system is dirty. Energy accounts for two-thirds of greenhouse-gas emissions; the pollution from burning fossil fuels kills over 4m people a year, mostly in the emerging world´s mega-cities.

A picture of the new energy system is emerging. With bold action, renewable electricity such as solar and wind power could rise from 5% of supply today to 25% in 2035, and nearly 50% by 2050. Most important, decarbonizing energy will avoid the chaos of unchecked climate change, including devastating droughts, famine, floods and mass dislocation. Once mature, it should be more politically stable, too, because *supply will be diversified, geographically and technologically*. Fossil-fuel-free renewable energy accelerates, as it must. The move to a new energy order is vital.[11] As detailed in previous paragraphs, the importance of hydrogen as a future energy vector in the next decades within the global landscape, the causes that originate research, development and the establishment of a hydrogen-based economy will be analyzed. Some aspects that currently drive the development of hydrogen will be addressed, as well as in the near future, the technological trends that will require the consumption of said energy.

Climate change: World emergency

Ten years we have to avoid a global catastrophe of droughts, food shortages, and forest fires. The 2015 UN 2030 Agenda, signed by 193 countries, includes 17 Sustainable Development Goals (SDG) and 167 goals.

In its latest report, the United Nations (UN) is blunt: 2030 is the deadline to avoid a global catastrophe: "governments must make rapid and unprecedented changes in all aspects of society."

"The planet will reach the crucial threshold of 1.5 degrees Celsius above pre-industrial levels by 2030," notes the United Nations Intergovernmental Panel on Climate Change (IPCC). Most analysis models predict that there will be less than a million square kilometers of sea ice in the middle of this century. For Kosonen "we are already in the danger zone". Bothe poles are melting at an accelerated rate: which will precipitate the risk of extreme drought, forest fires, floods and shortages of food for animals and millions of people. "The next decade is key," says Joeri Rogelj, a scientist at Imperial College London. A coalition of important figures including former UN chief Ban Ki-moon, billionaire Bill Gates and World Bank CEO Kristalina Georgieva, launched in 2018 an important message: "It is not enough to limit global warming even more, we must to do a lot to make sure to will we survive…too." Ban Ki-moon was blunt: "Around 100 million people could fall back into extreme poverty by 2030 due to climate change.[12]"

Trends in global CO2 and total greenhouse gas emissions-2019 report

In the 2018, the growth in total global greenhouse gas (GHG) emissions (excluding those from land-use change) resumed at a rate of 2.0%, reaching 51.8 gigatonnes of CO_2 equivalent ($GtCO_2$ eq) after six years, with a somewhat lower annual growth of around 1.3% (Figure 2). In 2018, the 2.0% (1.0 $GtCO_2$ eq) increase in global GHG emissions was mainly due to a 2.0% increase in global fossil carbon dioxide (CO_2) emission from fossil-fuel combustion and those form industrial non- combustion processes including cement production. Global emissions of methane (CH_4) and nitrous oxide (N_2O) increased by 1.8% and 0.8%, respectively. The 2.0% growth in GHG emission is higher than the annual average increase of 1.2% since 2012, but lower than the 2.5% increase over the first decade of this century (Figure 2). Fossil CO_2 emissions are the largest source of global GHG emissions, with a share of about 72%, followed by CH4 (19%), N2O (6%) and F-gases (3%). The GHG emission growth over the past year and higher rate of 2.0% in2018 are quite similar to increase in CO_2 emissions, which contribute almost three quarters to total GHG emissions (excluding those from land-use change).

On a global level, the year 2018 was among the five warmest year (2014-2018) since records began in 1880. Of the 10 warmer year since 1880, occurred since 2005. In 2018, temperatures across much of the world were warmer to much warmer than average. Record warm temperature were measured across much Europe, the Middle East, New Zealand and parts of Asia. A heatwave of unprecedented intensity and duration struck Europe, from 18 to 22 April. France, Germany and Switzerland had their warmest year since national records began. The Netherlands had its second warmest year on record (with 2014 being the record year). The departure from the average global temperature level was 0.97 ^oC the 1880-1900 average, just slightly below those of the year 2015-2017.

In 2018, the growth in total global GHG (GHG) emissions (excluding those from land-use change resumed at a rate of 2.0% (+/-1%), reaching 51.8 gigatonnes of CO_2 equivalent[11,12] ($GtCO_2eq$)

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after six years (since 2012), with a somewhat lower annual growth of 1.3% on average and compared with the much higher average annual growth rate of 2.5% in the first decade of this century (Figure 3). This new time series marks the end of global emissions peaking in 2015 and 2016. The annual growth rate of 2.0% in 2018 was twice as high as the average growth since 2012, when the average greenhouse gas emission growth was also 1.0% per year (Figure 3).

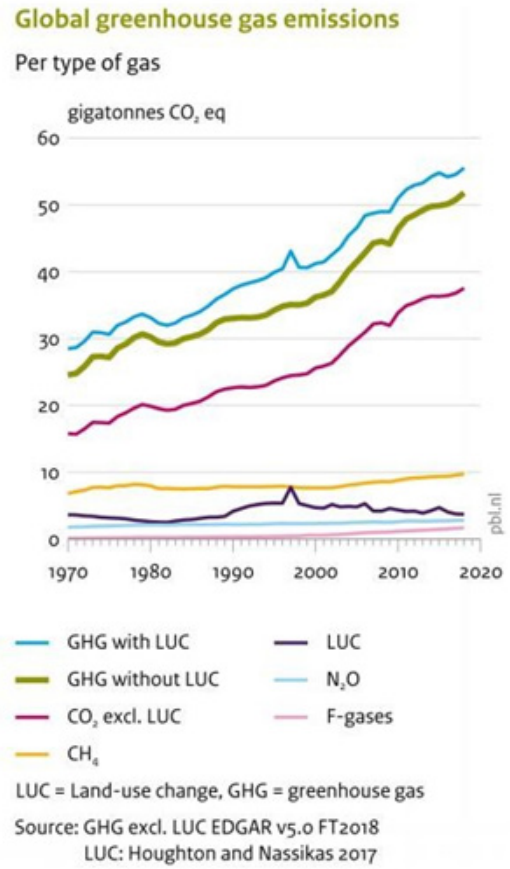

Figure 2 Growth in global greenhouse gas emissions in 2018 highest since 2011(Retrieved from https://www.pbl.nl/sites/default/files/downloads/pbl-2020-trends-in- global-co2-and-total-greenhouse-gas-emissions-2019-report_4068.pdf).

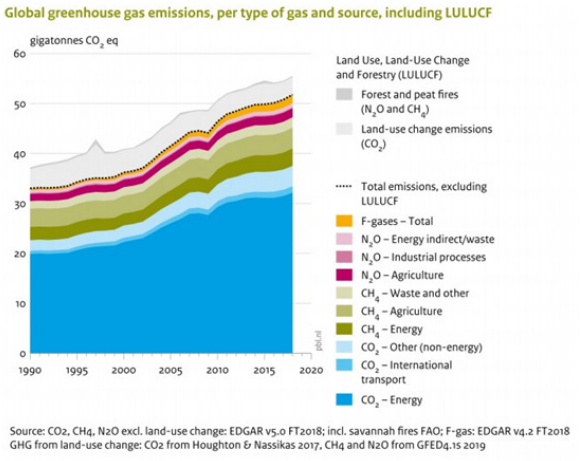

Figure 3 Global greenhouse gas emissions, per type of gas and source including LULUCF. (Retrieved from https://www.pbl.nl/sites/default/files/downloads/pbl-2020-trends-in-global-co2-and-total-greenhouse-gas-emissions-2019-report_4068.pdf)

In 2003, global greenhouse gas emissions growth accelerated to 3.9% and remained high through 2007 (the average increase was 3.6% over these years), which was related to the fast industrialization of China, since the country became a member of the World Trade Organization (WTO) (Figure 3). Please note that global economic crisis was in 2008-2009. In our analysis of recent trends in emissions and drivers, we focus on the 2010-2018 period and include the first decade of this century, for a broader perspective.

The Sustainable Development Goals (SDGs) constitute a universal call to action to end poverty, protect the planet and improve the lives and perspectives of people around the world. In 2015, al United Nations Members States approved 17 Objectives as part of 2030 Agenda for Sustainable Development, which establishes a plan to achieve the Objectives in 15 years. The year 2020 should mark the beginning of a decade of ambitious action in order to achieve the 2030 Objectives.

Main goals of sustainable development goal 7 (SDG7)-affordable energy:By 2030, ensure universal access to affordable, reliable and modernenergy services.By 2030, significantly increase the proportion of renewable energy inall energy sources.

I. The five largest emitters of GHG, together accounting for 62%, globally, are China (26%), the United States (13%), the European Union (more than 8%), India (7%), and the Russian Federation (5%) and Japan (almost 3%). These countries also have the highest emission levels (Figure 4).

II. Global CO_2 emission shows largest increase since 2011, and China showed very high annual growth in CO_2 emissions due to its rapid industrialization.[13]

III. By 2030, double the global rate of energy efficiency improvement.

IV. By 2030, increase international cooperation to facilitate access to research and technology related to clean energy including renewable sources, energy efficiency and advanced and less polluting fossil fuel technologies, and promote investment in energy infrastructure and clean technologies

V. By 2030, expand infrastructure and improve technology to provide modern and sustainable energy services for all in developing countries, in particular least developed countries, small island developing States and landlocked developing countries, in line with their respective support programs.

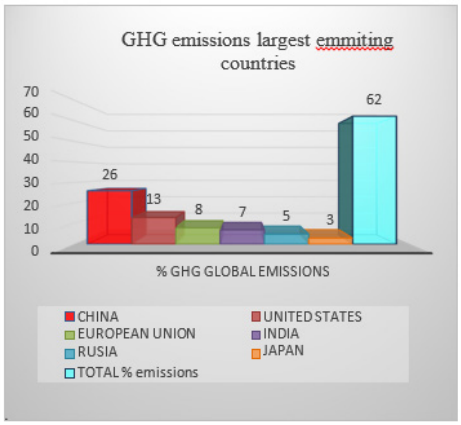

Figure 4 Global greenhouse gas (GHG) emissions, five largest countries emitters of GHG.(Retrieved from https://www.pbl.nl/sites/default/files/downloads/pbl-2020-trends-in-global-co2-and-total-greenhouse-gas-emissions-2019-report_4068.pdf).

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The use of renewable energy in sectors such as heating and transportation should transportation be increased. Likewise, *public* and *private investment in energy are necessary*; as well as higher levels of financing and polices with bolder commitments, in addition to the willingness of countries to adopt new technologies on a much broader scale. Given that there are only ten years left to achieve the Sustainable Development Goals, at the Summit on the SDGs held in September 2019, world leaders requested a decade of action and results in favor of sustainable development, and promised to mobilize financing, improve the application at the national level and strengthen the institutions to achieve the Objectives by the scheduled date, the year 2030, without leaving anyone behind.

The Secretary General of the Unite Nations called for all sector of society to mobilize in favor of a decade of action at three levels: world action to ensure greater leadership, more resources and smarter solutions regarding the Sustainable Development Goals; action that includes the necessary transitions in the policies, budgets, institutions and regulatory frameworks of governments, cities and local authorities; and action by people, including youth, civil society, the media, the private sector, trade unions, academic circles and other stakeholders, to generate an unstoppable movement that drives the necessary transformations.[14]

Links to sustainable development goal 7 (SDG7)-affordable energy: sustainable energy for all

About this org:

Sustainable Energy for All (SEforALL) is an international organization working with leader in government, the private sector and civil society to drive further, faster action toward achievement of Sustainable Development Goal 7 (SDG7), which call for universal access to sustainable energy by 2030, and the Paris Agreement, which calls for reducing greenhouse gas emission to limit climate warming to below 2º Celsius. Theirs work also supports progress against the decarbonization targets laid out in the Paris Agreement.[15]

United Nations development program (PNUD)

Unsustainable models of energy production and consumption threaten health and quality of life, while affecting ecosystems and contributing to climate change. Therefore, sustainable energy can be an engine in poverty reduction, social progress, equity, resilience, economic growth and environmental sustainability. The PNUD supports and promotes a transformation of the energy sector market through a series of interventions in policies, finance,capacity building and awareness raising. Promoting investments that help obtain sustainable energy products and services, and reducing the risk of the political and financial environment.[16]

United Nations industrial development organization (UNIDO)

UNIDO is the specialized agency of the United Nations that promotes industrial development for poverty reduction, inclusive globalization and environmental sustainability. UNIDO is promoting Inclusive and Sustainable Industrial Development (ISID) to harness the full potential of industry`s contribution to the achievement of sustainable development, and lasting prosperity for all. UNIDO is convinced that ISID will be a key driver for the successfully implementing in our current era of globalization through available knowledge, technology, and innovation. The *private sector* is an important vehicle for technology development and innovation, representing a hub for technical progress.[17]

United Nations-energy (UN-Energy)

UN-Energy, the United Nations´ mechanism for inter-agency collaboration in the field of energy, was established in 2004 as subsidiary of the Chief Executive Board, reporting to the High-Level Committee on Programmes, to help ensure coherence in the United Nations system´s multidisciplinary response to the World Summit on Sustainable energy.[18] We are in a global climatic emergency, today is when we must focus scientific research on the development of hydrogen as the most abundant sustainable resource in the universe. We must participate together with the government, private sectors and institutions of higher educations and develop joint projects. As the hydrological resources in the state of Veracruz were analyzed, we have potential rivers to detonate a sustainable hydrogen-based industry, and therefore a green economy. The future depends on what we to do today, we cannot delay the development of renewable energies, the end of fossil fuels will come soon and we must to work now, in the energy transition, towards a cleaner andmore sustainable world. "The future is uncertain and we cannot predict it, but we must be ready for its arrival" says Andreas Schleicher, director of Education and Skills of the Organization for Economic Cooperation and Development.[19]

Future hydrogen vector that will boost global demand

I. Over the next few year, cities across the planet will increase to 3000 million by 2030.

II. In 10 years, global food demand will increase 50%, *energy demand* 45% and water demand 30% according to a repkort published by the High Level Panel on Global Sustainability, designated by the UN.

III. The world population will be mostly urban 60%, according to *The Economist.*[20]

IV. The digital government, the Internet of things (IoT), artificial intelligence and the 5G network revolutionize information technology (IT) services.

V. For example, technologies such as autonomous vehicles require adequateinfrastructure that allows them to make decisions in the shortest possible time.

VI. To satisfy this need, the IT industry is committed to *edge* or "border" technology that is, data minicenters near the place where information is generated and processed, details Herve Tardy, vice president of EATON, a US multinational management of energy.

VII. "The trend will be hybrid infrastructure: what is more sensitive to latency (speed at which information travels from point to point) be closer and the rest will be distributed in public and private clouds and computers centers," he says.

VIII. In addition, the industry should improve the uses of the temperature of the environment to obtain greater *energy efficiency*, increase both physical and digital security and grater intercom processing capacity says Juan Pablo Borray, director of Business Development at Panduit.

IX. IT services has grown at an annual rate of 14% since 2017.[21]

Experts says that this year (2020) will be the beginning of the association of all the leading technologies of the last decade to create fully coupled environments that can work autonomously in order to build companies, work spaces, smarter cities and interconnected capabilities. Artificial Intelligence (AI), the Internet of Things (IoT),

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automation, Machine Learning, 3D printing and 5G connectivity will be responsible for giving this momentum.[22] 30% of jobs will be automated by 2030. 15% of cars will be autonomous in the next decade. 125 million devices connected to the Internet of things will be in ten years.[23] According to estimates by the United Nations Organization (UN), in 2050 it is estimated that 68% of the world's population will live in urban areas, which would result in an increase of 2,500 million people.

In Mexico, the capital of the country will become the tenth most populous city in the world, with 23, 3 million inhabitants, according to projections of the Global Cities Institute. The manufacturers of transport systems agree on two things: the mobility of these types of populations would be through electric and even autonomous modes.

Autonomous and electrical systems and mobility policies would reduce emissions by 80%. Car manufacturers will continue with the electrification trend at an annual growth rate of between 28 and 37%, and within 30 year more than 200 million alternative vehicles could circulate in the world, according to estimates by Goldman Sachs and Bloomberg.[24] "We are not a company that is particularly thinking of self-employed but we have seen the trends and we know we have to there," said Lutz Meschke, appointed director of the board of directors and member of the board of finance and technology executives of Porsche AG by Chavez Gabriela.

"In 2040, renewable energies will continue to gain ground and when combined with natural gas and emerging technologies, such as micro- networks, they will be able to create robust energy systems of high efficiency and low carbon emission. Advanced biofuels are envisioned through algae, carbon sequestration and new *hydrogen*-associate technologies," said Enrique Hidalgo president of Exxonmobil Mexico.[25] "There is a dilemma and trend that will continue to determine the energy sector in following years and is the decentralization of energy. The probability that Mexico will become a country with energy deficit has increased in recent years, in a world where oil it is increasingly scarce and expensive. It is necessary to stop thinking that this input is necessary and to use it is strategically, and not as an economic and energy base. To achieve this objective, the country must consider all energy markets, including natural gas, electricity and renewable energy," said Enrique Gonzalez Haas, General Director of Schneider electric Mexico and Central America.[26]

"In 50 years it will reach between 60 and 70% of the total electricity generation worldwide. But my personal impression is that the renewable plant has always broken forecasts and that this will be higher. We will see a quantum leap with Hydrogen that still has limitations, but it will be a disruptive and competitive technology against batteries to store energy (litio battery)," said Paolo Romanacci, CEO of Green Power Mexico and Central America.[27] The issuance of green bonds allows to finance sustainable projects, such as solar power plants, hydroelectric plants or saving buildings.

Richard Turnill, global head of Investment Strategies at Black Rock points out that sustainable investments are gaining popularity in the world. "The issuance of bonds is due to the fact that the reception of investors has been favorable and there is an increasing interest in these instruments because the projects to which the green bond resources are destined are more adapted to the world that is coming," says Eduardo Piquero, director of Mexico CO_2. For the manager, this type of bond decreases the financial risk that have to do with climate change. For example, investments in oil, gas o other fossil fuels will tend to lose value in the market, because the international trend is committed to other types of energy, "adds the specialist. In Mexico there are still many areas of opportunity for these instruments to grow even more. According to the UBS investor Watch study, globally. Investors expect the proportion of sustainable investments to increase from 39 to 49% overthe the next five years and a majority (58%) believe they will become the norm within a decade.

Conclusion and discussion

The new technologies that emerging now and the future immediate will need a highs supply of energy based on hydrogen. For this reason, it is necessary to combat climate change through policies that develop an economy based on sustainable energy. There are large hydrological reservoirs such as rivers and lakes, as well as

sufficient amounts of sunlight in most part of the year, where they can be exploited sustainably through adaptive technologies on the hydrogen´s production in regions with emerging or underdeveloped economies.

These technologies, adaptable to the must be adaptable to the environment or region where they will be used for hydrogen production, must have certain technical characteristics: they must be mobile, modular, scalable and technologically upgradable.

In a future article as continuous of this, we will delve deeper into these technologies to be used for the production of hydrogen in these emerging or underdeveloped regions. The relevance of this study is to find a rapid technological solution that is not very complex that allows the mitigation of greenhouse gas emissions

into the atmosphere and thus comply with the the Goals 7: Affordable and Clean Energy; Goal 9: Industry, Innovation and Infrastructure; Goal 11: Sustainable Cities and Communities; Goal 12: Responsible Consumption and Production and Goal 13: Climate Action from the Sustainable Development Goals 2030.

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Conflict of interest

The authors declare there is no conflict of interest.

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